2019 Version

Reproduction

of Flowering Plants

Junior Science

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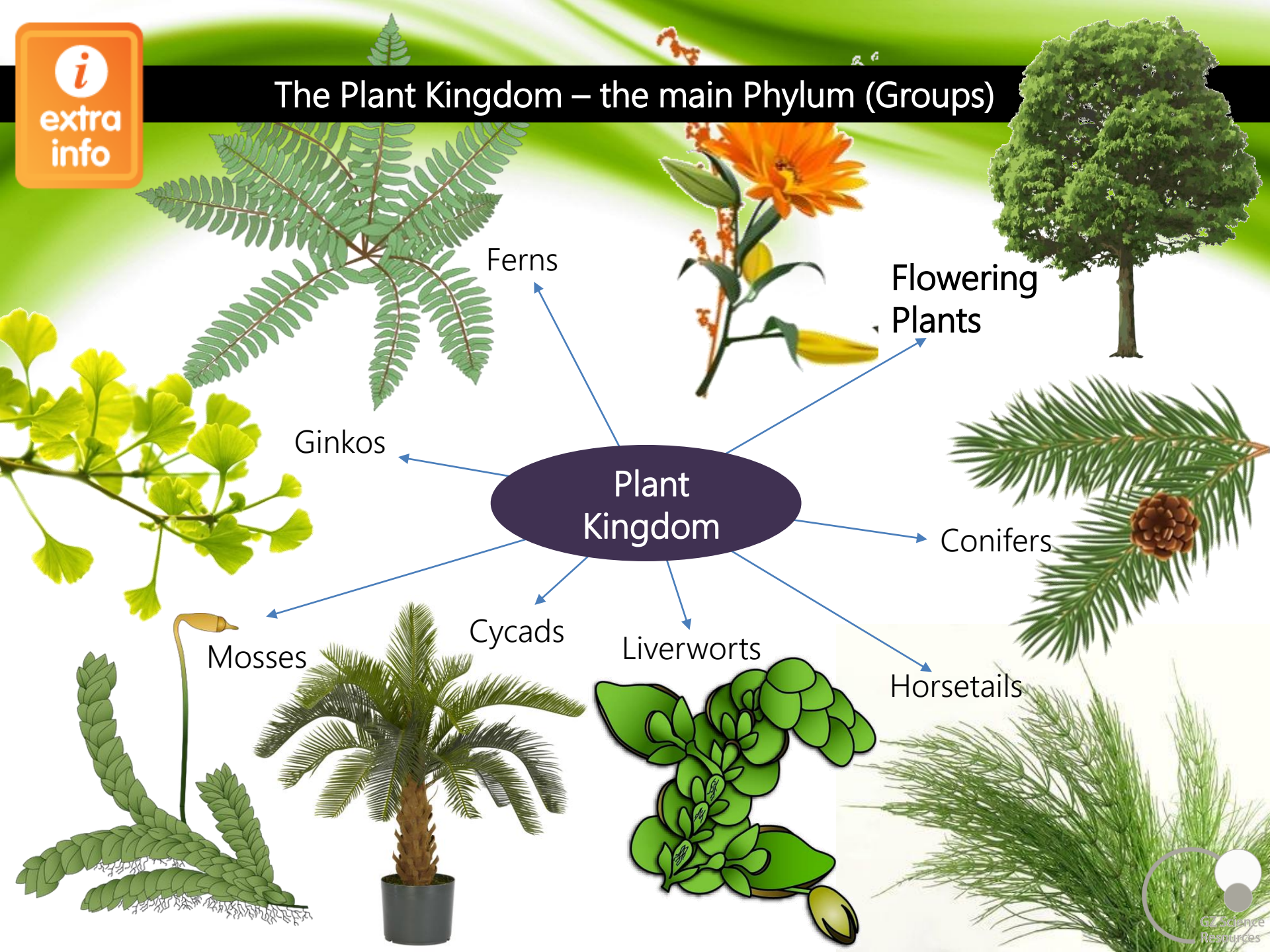
The Plant Kingdom

All plants belong to the same **kingdom (Plantae)**. Plants are called **autotrophs**, which means they make their own food through the process of photosynthesis which also produces sufficient **oxygen** to the atmosphere to allow living organisms to respire. Plants have laid down the **fossil fuels** that provide humans with energy. Every other animal relies on plants either directly or indirectly for nutrition.

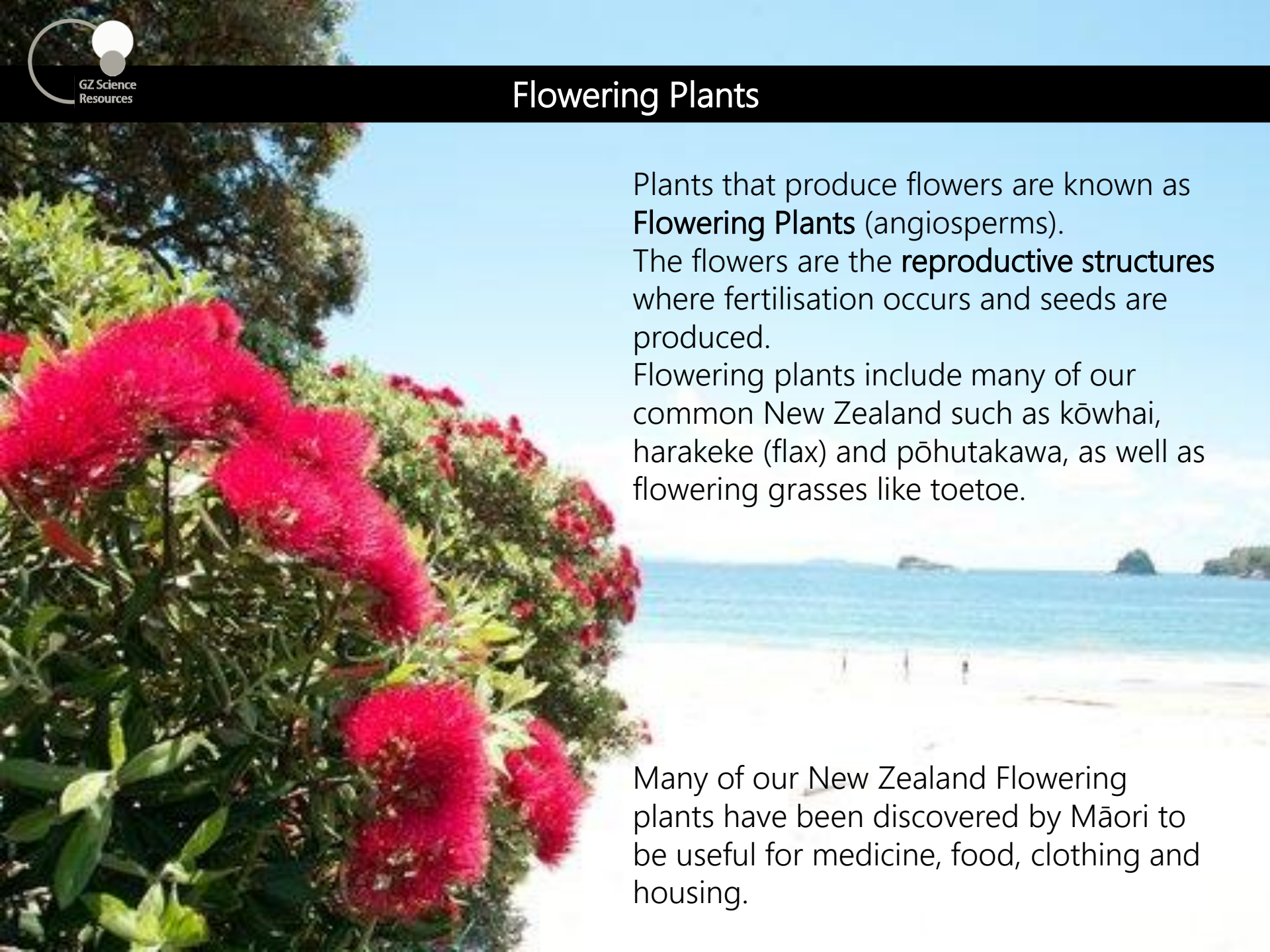
Plants grow mainly on land but also can be found in the oceans and fresh water. They have been on Earth for millions of years. Plants species currently number about 260,000.

The Plant Kingdom – the main Phylum (Groups)

extra info



Flowering Plants



Plants that produce flowers are known as **Flowering Plants** (angiosperms).
The flowers are the **reproductive structures** where fertilisation occurs and seeds are produced.
Flowering plants include many of our common New Zealand such as kōwhai, harakeke (flax) and pōhutakawa, as well as flowering grasses like toetoe.

Many of our New Zealand Flowering plants have been discovered by Māori to be useful for medicine, food, clothing and housing.

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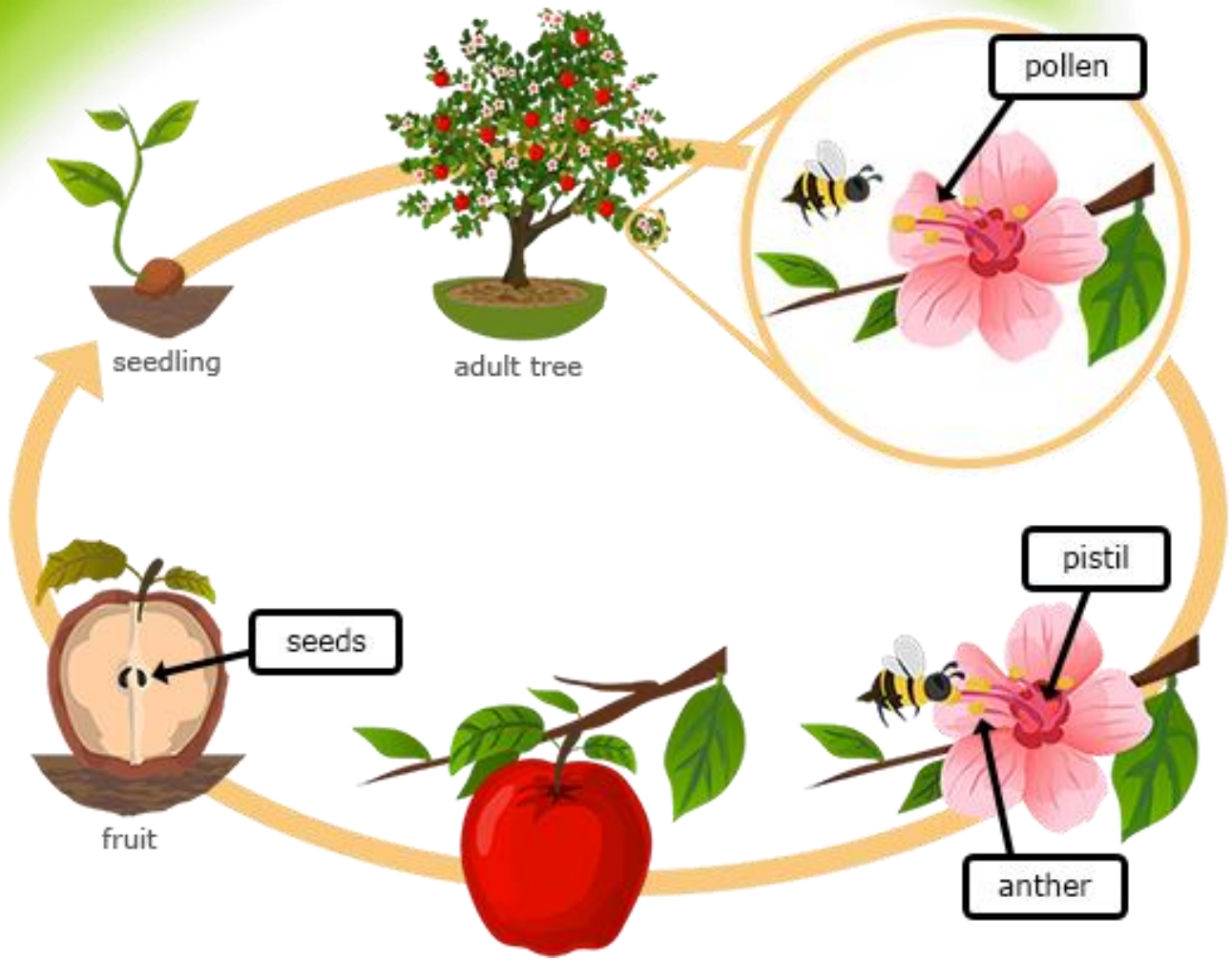
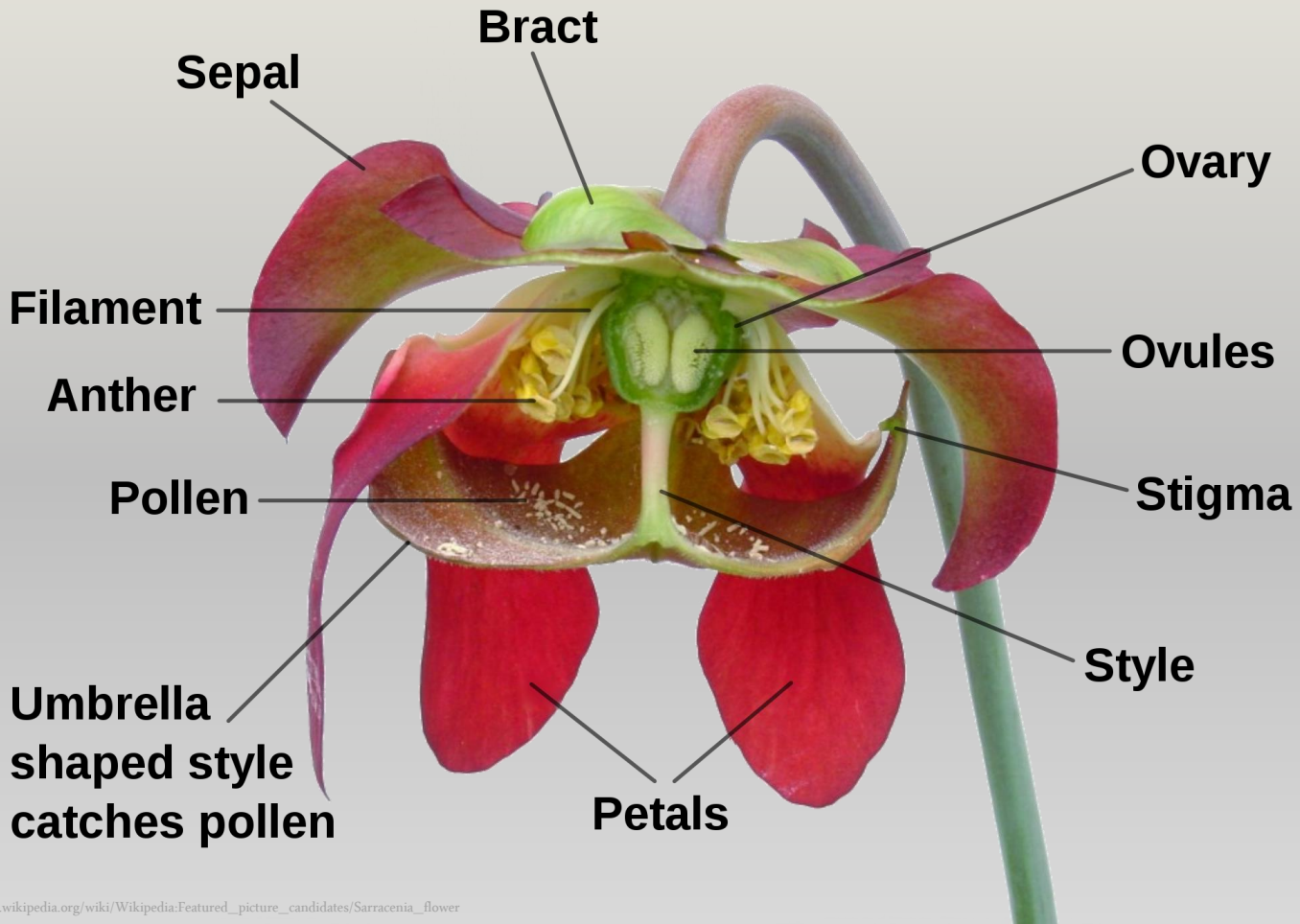
Flowering Plant life cycle



All flowering plants develop flowers that produce male pollen and female eggs. The number and structure of these depend on the species of plant.
The reproductive cycle involves the transfer of pollen to the egg in the flower (**pollination**), the joining of the pollen and egg to make a seed (**fertilisation**) and the spreading of seeds to grow a new plant (**seed dispersal**)

https://www.ixl.com/science/grade-5/flowering-plant-and-conifer-life-cycles

The structure of a flower



Insect / bird - pollinated flowers have visible, often colourful petals that surround the flower's sexual reproduction parts. The petals can "advertise" for specific **pollinators** through their shape, size, colour and sometimes smell. The flowers are surrounded by sepals, which are small and usually green structures that protect the flower as its developing.

https://en.wikipedia.org/wiki/Wikipedia:Featured_picture_candidates/Sarracenia_flower

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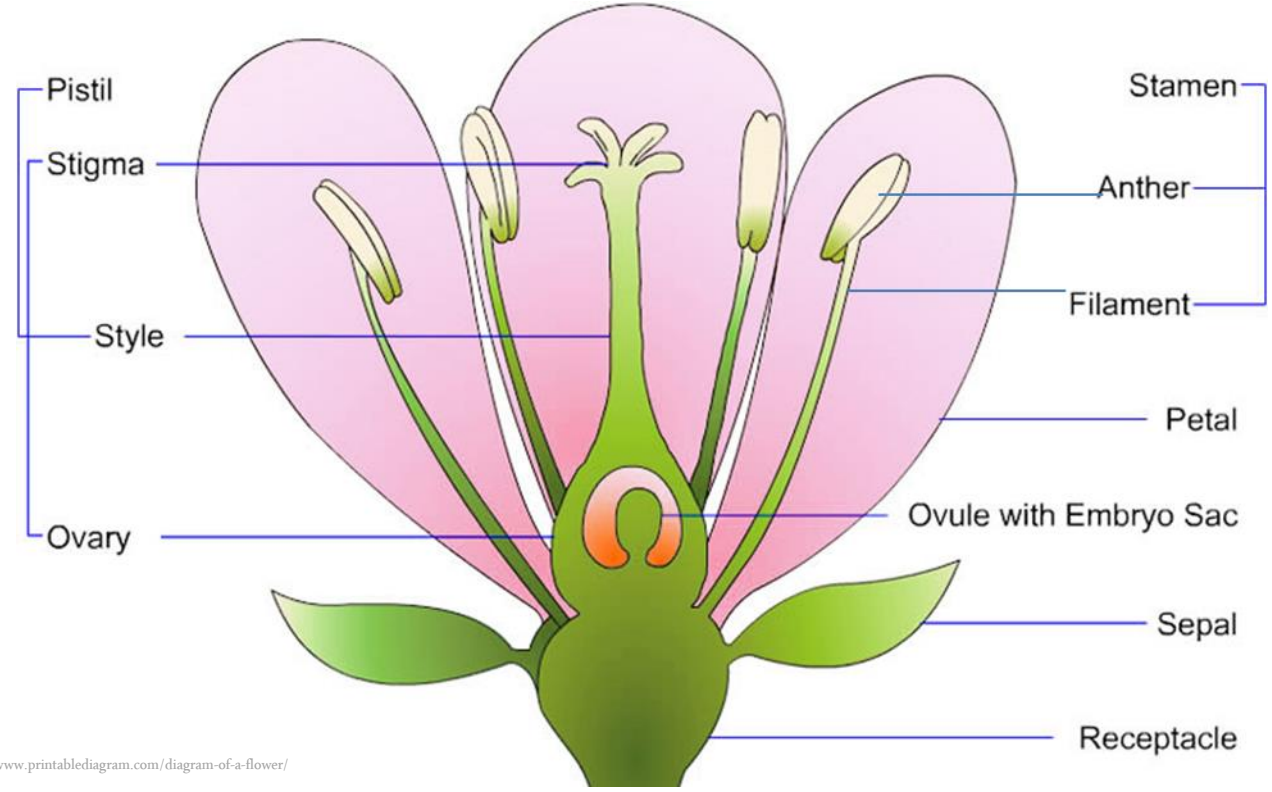
Drawing and labelling a flower

The main parts of a typical flower that is pollinated by an animal such as a bird or insect, is shown below in a cross-section drawing. Many flowers often have many anther/filaments surrounding one central stigma/style. When labelling, one of each is required.



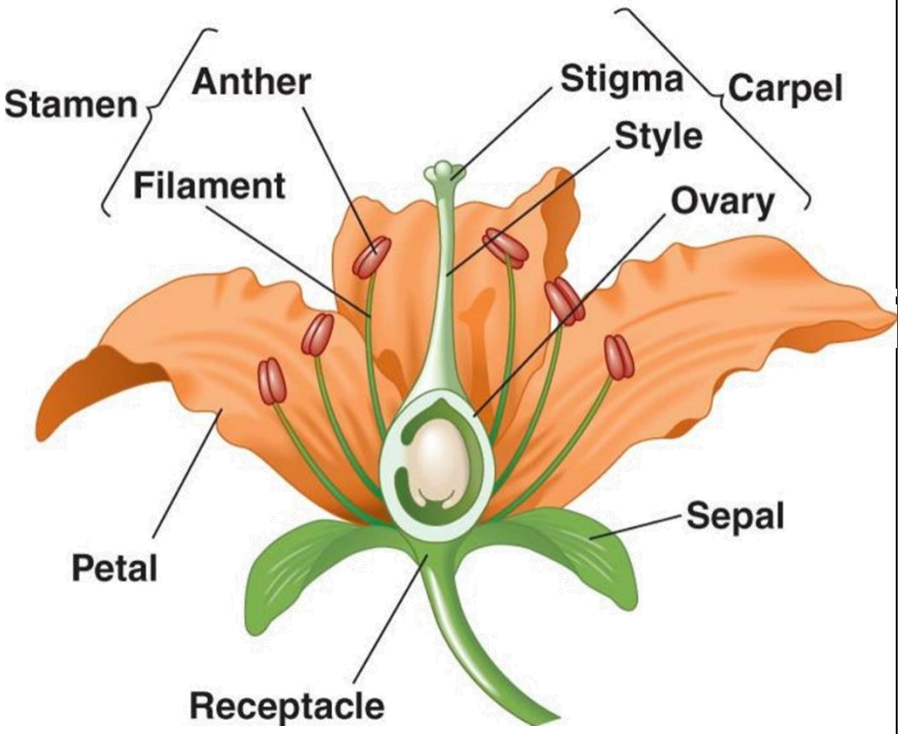
Reminders for Biological drawing:

- ❑ Clean single lines
- ❑ Label all parts
- ❑ Do not cross over lines

http://www.printablediagram.com/diagram-of-a-flower/

The reproductive parts of an insect-pollinated flower

<u>The male part</u> of a flower is called the **stamen**. The pollen is produced in the **anther** which is held up by the **filament**. The pollen is collected by a pollinator. (or spread by wind) The pollen contains male sex cells (**gametes)** which will later join with the female gametes in the ovule during fertilisation.

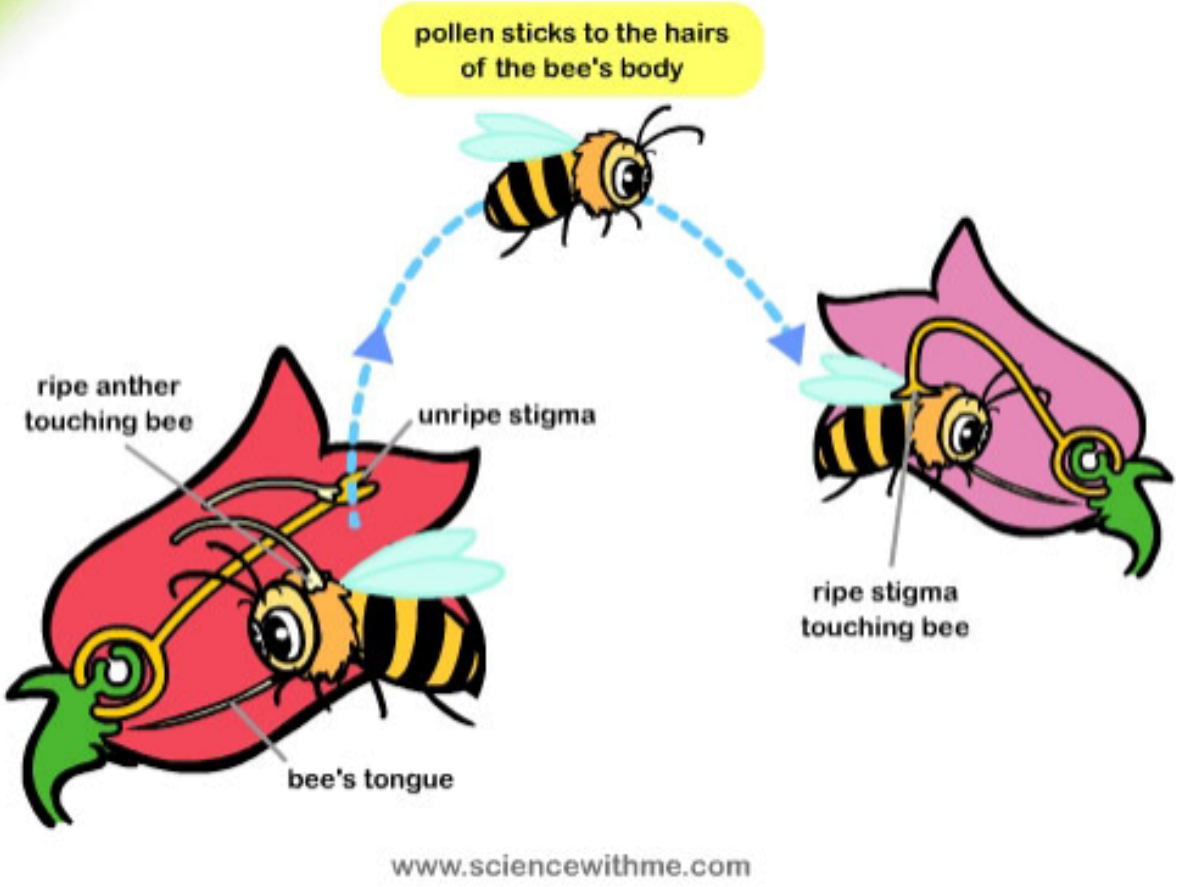


https://humananatomyly.com/flower-diagram-without-labels/

<u>The female part</u> of the flower is called the **pistil (or carpel)**. The pollen from a male part of a flower is brought to the stigma by a pollinator. This process is called **pollination**. The pollen travels down the **style** into the **ovary** to join with an egg cell inside the ovules in a process called **fertilisation**.

Pollination

Pollination is the transfer of pollen from the male part of the flower to the female part. Flowers can be wind-pollinated or animal-pollinated. Animals that assist in pollinating a flower are known as pollinators.



Insect-pollinated flowers often contain **nectar**, a sweet sugar produced by the plant, to attract an insect. As the insect reaches into the flower for the nectar it may be brushed with pollen from the anther. If the insect moves to another flower it may brush the pollen against the stigma and therefore pollinate the flower.

Flowers ripen their male and female parts of the flower at different times to prevent **self pollination**.

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Summary of pollination in plants

1. The male parts of the flower are the **anther** and **filament**
2. The female parts of the flower are the **stigma**, **style** and **ovary**
3. Male gametes are found in **Pollen** Produced in the **Anther**
4. Pollen needs to be moved to the female part called the **Stigma** of the same species of plant to reproduce
5. This process is called **Pollination**
6. Pollination can be helped by **Wind** Or **Animal**
7. An example of wind pollination is **grass plants**
8. A wind pollinated flower is most likely to look like - **small, green, unscented**
9. An example of animal pollination is a **rose plant pollinated by insects**
10. An animal pollinated flower is most likely to look like – **colourful, with large petals, perhaps with a scent**

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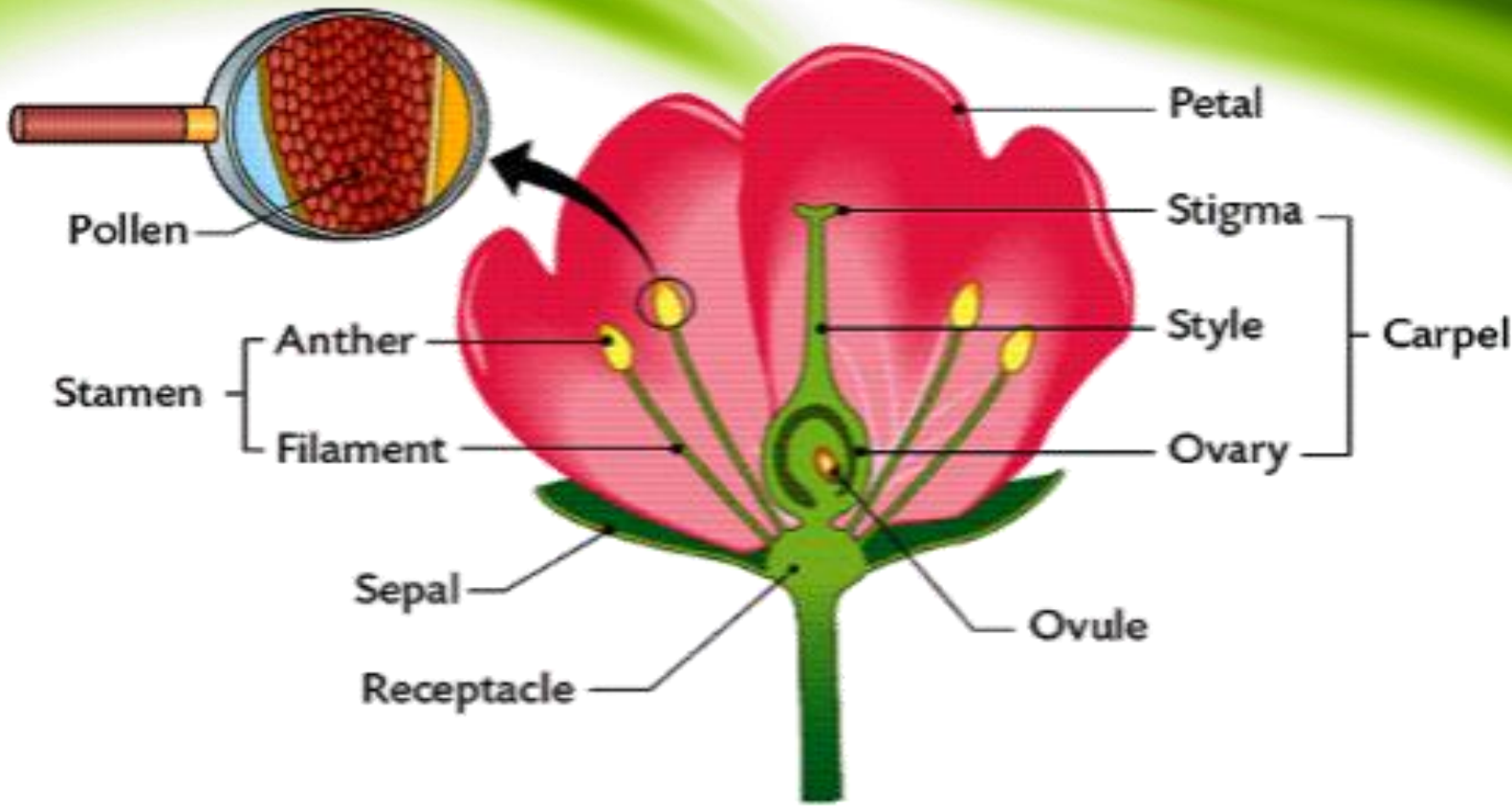
Functions of the ova and pollen



The pollen must be light enough to either be moved by wind or be attached to a pollinator and still enable it to fly.
The ova is the female equivalent to eggs and once fertilised will become the seed.
The number of ova will determine the maximum possible seeds each flower will produce, either as fruit, nuts or pods.

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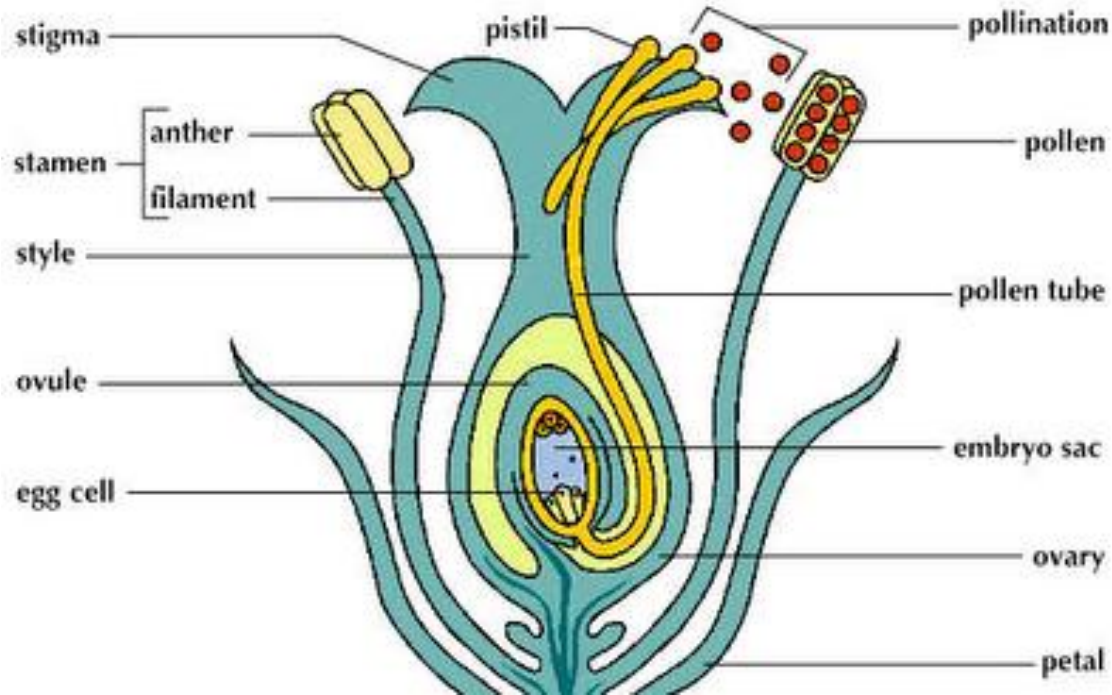
Fertilisation in flowering plants

1. Pollen from either the same plant (self-pollination) or another plant (cross-pollination) needs to arrive on the flowers stigma
2. The pollen sends a tube down the style to reach the ovule, and the male gametes (there are two in every pollen grain) enter the ovule to fertilise the egg (female gamete)
3. One male gamete joins with one female gamete to form a **zygote** and the plant is fertilised. (The fertilised ovule develops into a seed)

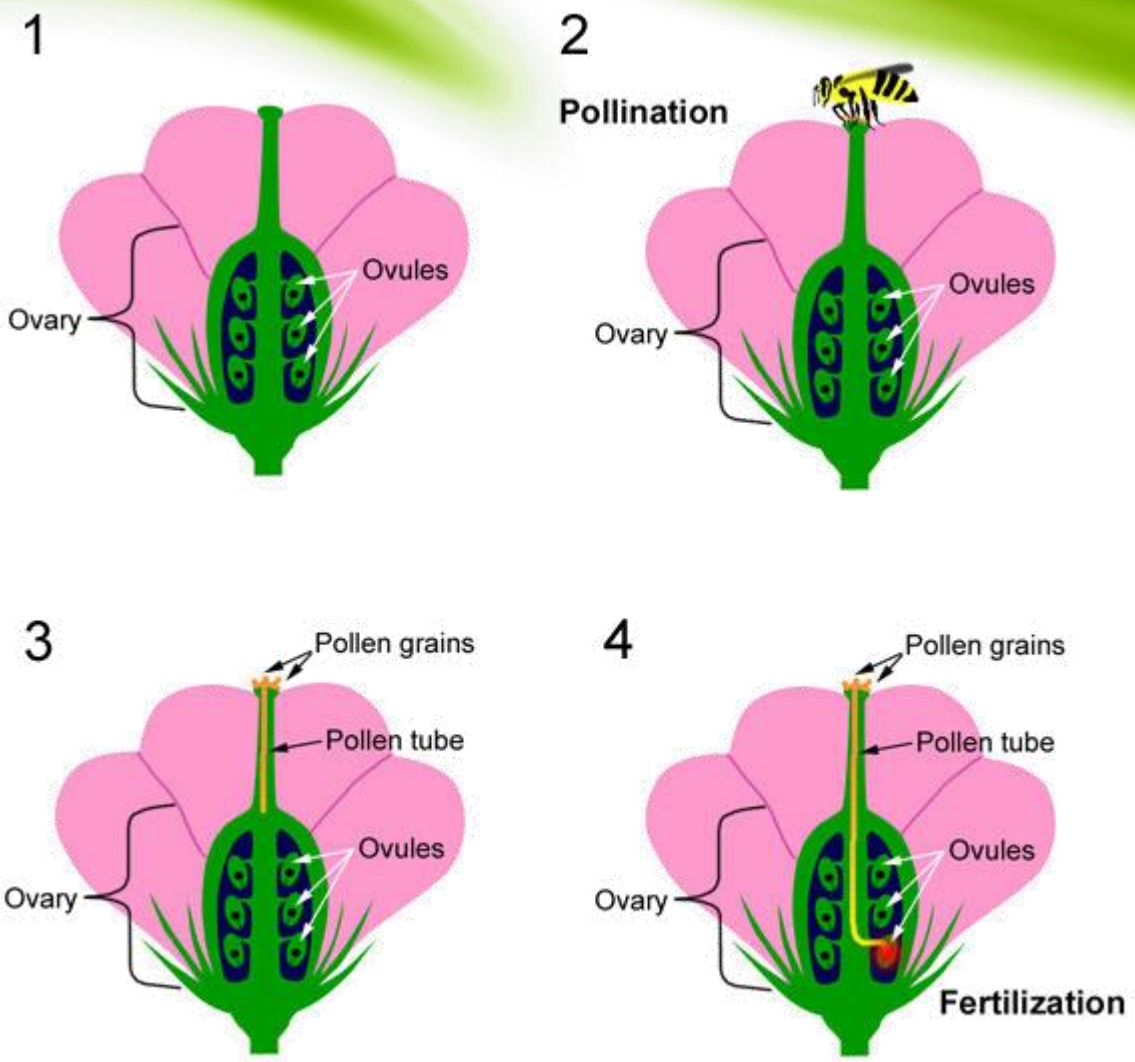


The differences between pollination and fertilisation in flowering plants

Pollination just refers to pollen landing on the female stigma of the plant. This can either be with a pollinator or wind.

Fertilisation refers to the sperm cell (that was in the pollen grain) joining with the egg cell to form a single cell (zygote).

Pollination does not always lead to fertilisation



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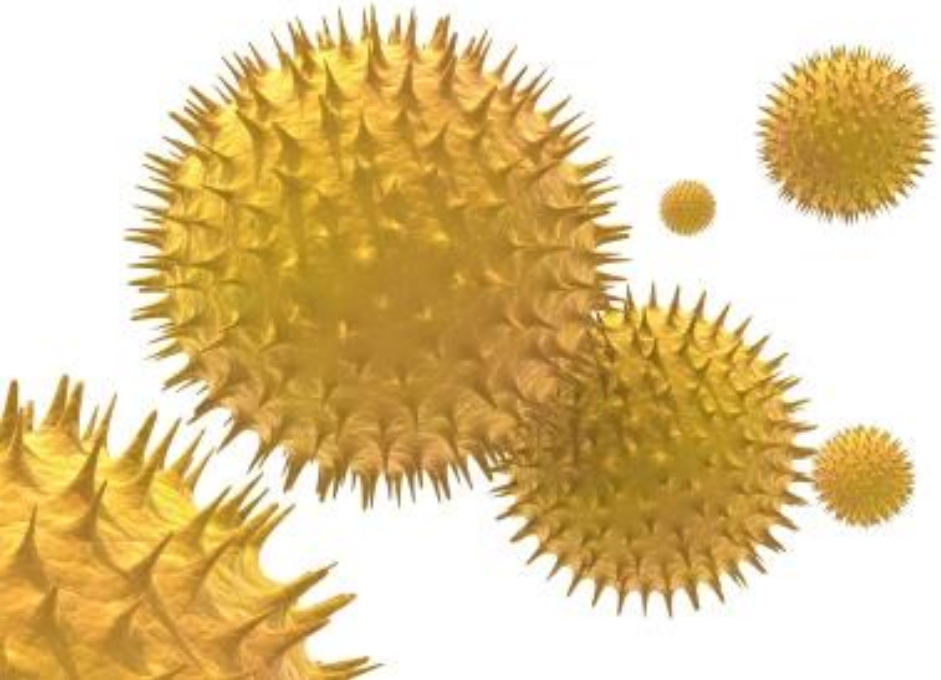
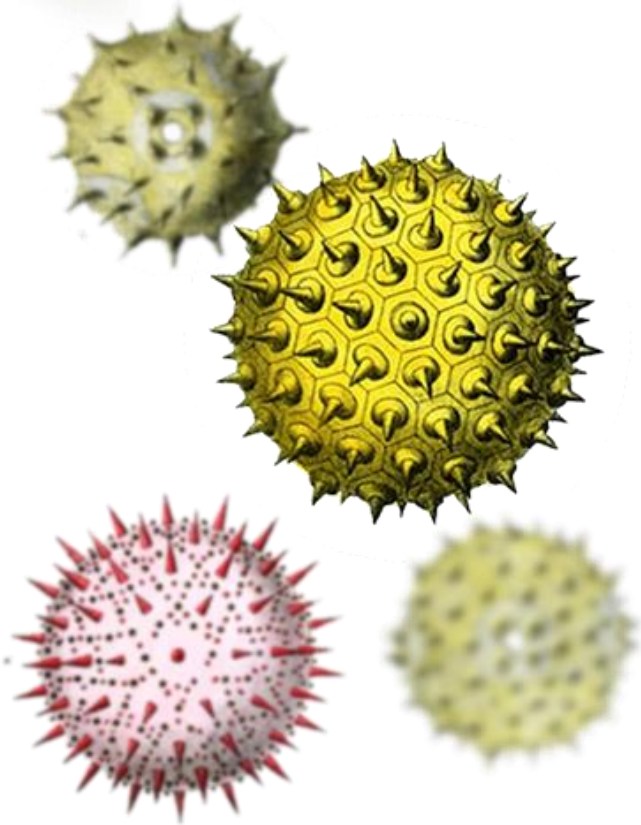
Different ways **pollen** may be transferred.

Pollen grains are tiny and they are light enough to be carried by the wind or on the bodies of flying and crawling animals.

Plants and their flowers have adapted to transfer their pollen from one flower to another in many different ways that include using wind, insects, birds, mammals and





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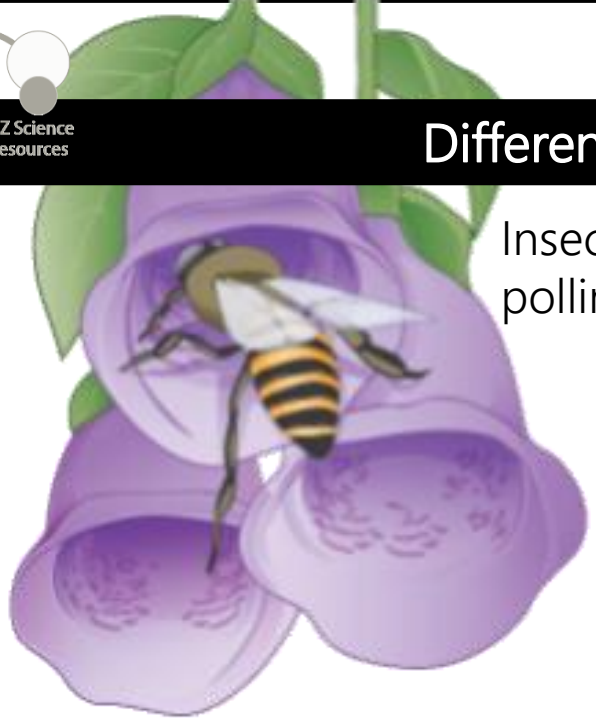
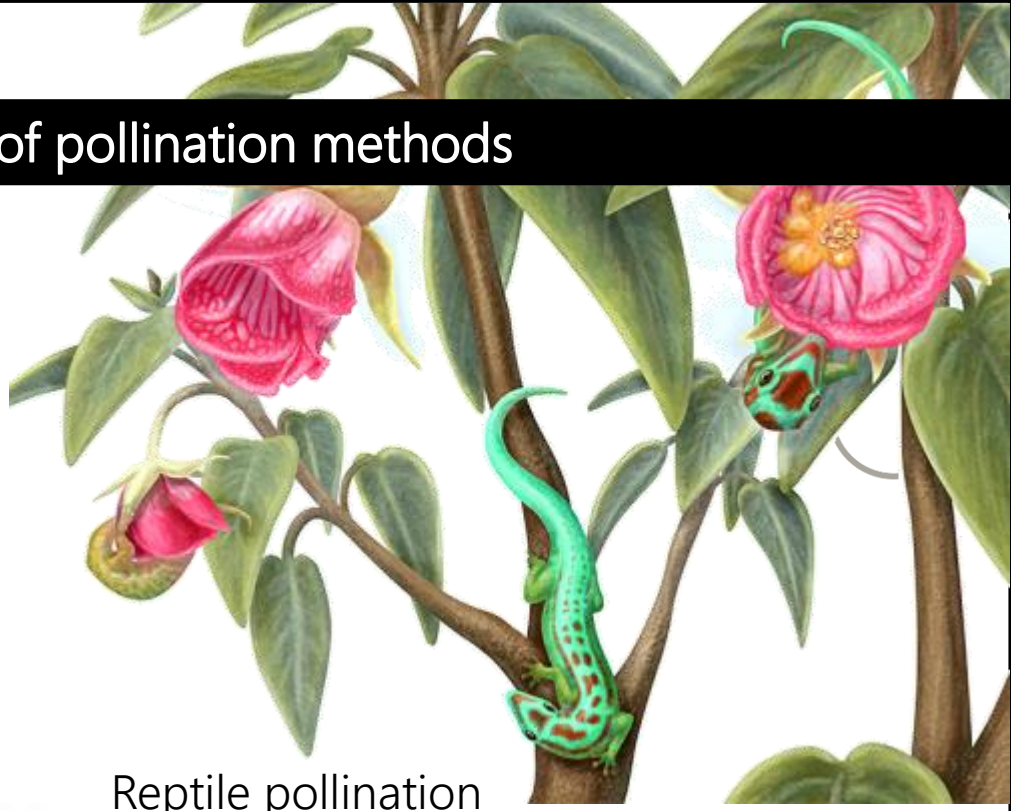
Different types of pollination methods



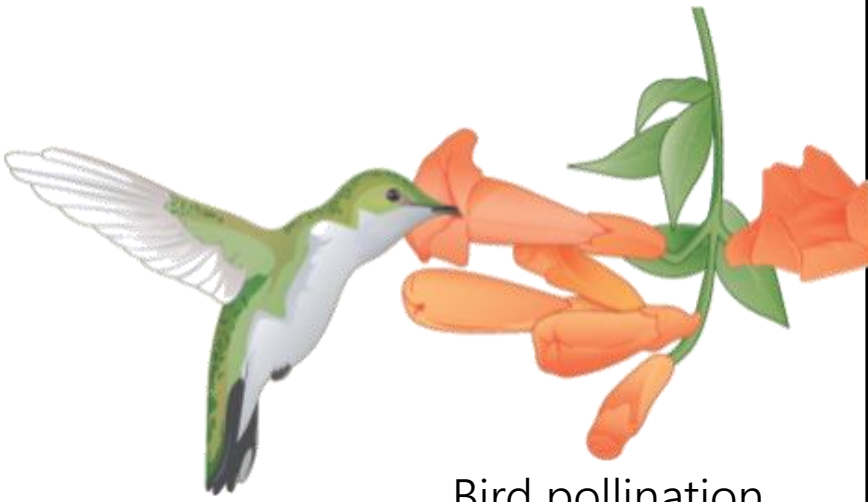
Insect pollination



Reptile pollination

wind pollination

mammal pollination



Bird pollination

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Examples of insect-pollinated flowers

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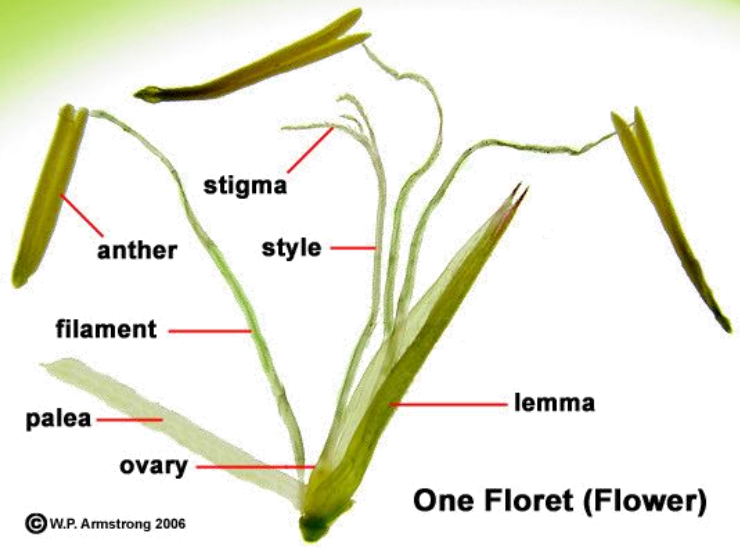
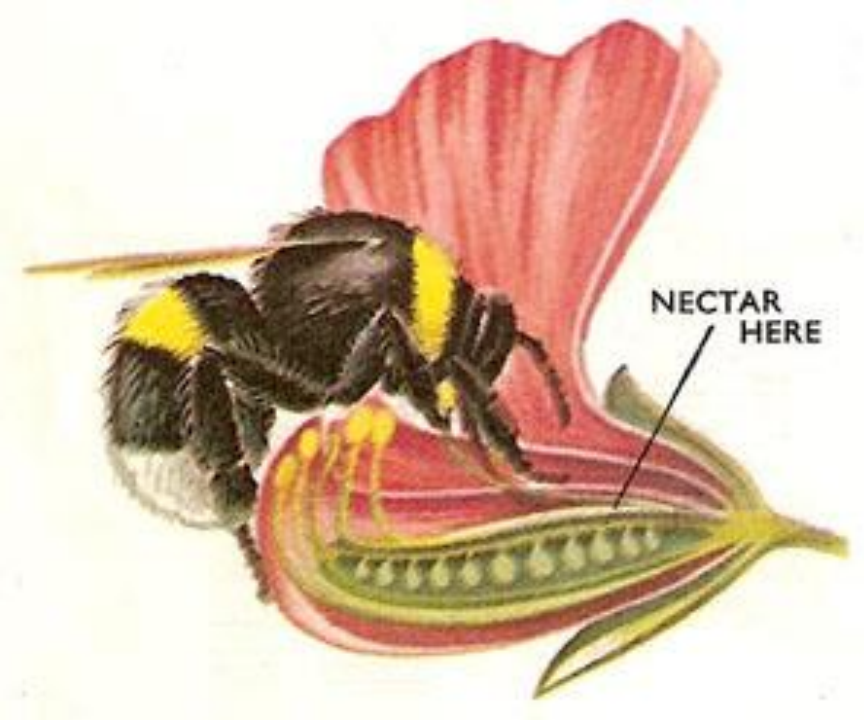
Examples of wind-pollinated flowers

The differences in structure between insect-and wind-pollinated flowers



Insect pollinated flowers are easily seen and often contain scent and nectar to attract the insects. The male parts are adapted so they make contact with the insect as it feeds from the flower.



Wind pollinated flowers are often small and green with no scent. Male anthers protrude out from the flower to allow the wind to pick up the pollen and disperse it away from the plant. Male and female parts develop at different times.

The differences in structure between insect-and wind-pollinated flowers
Summary

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Feature	Wind pollinated	Insect pollinated
petals	Small dull coloured petals	Large brightly coloured flowers
scent	Flowers do not have any scent	Flowers have scent to attract insects
stamen	Stamen is thin and hangs outside flower	Stamen is strong and inside the flower
pollen	Pollen grains are light and numerous	Pollen grains are sticky or hairy and are few in amount
stigma	Stigma is feathery to catch pollen and hangs outside the flower	Stigma is also hairy and sticky and is inside the flower
nectar	No nectar or nectary	Many have sweet nectar in a nectary to attract insects

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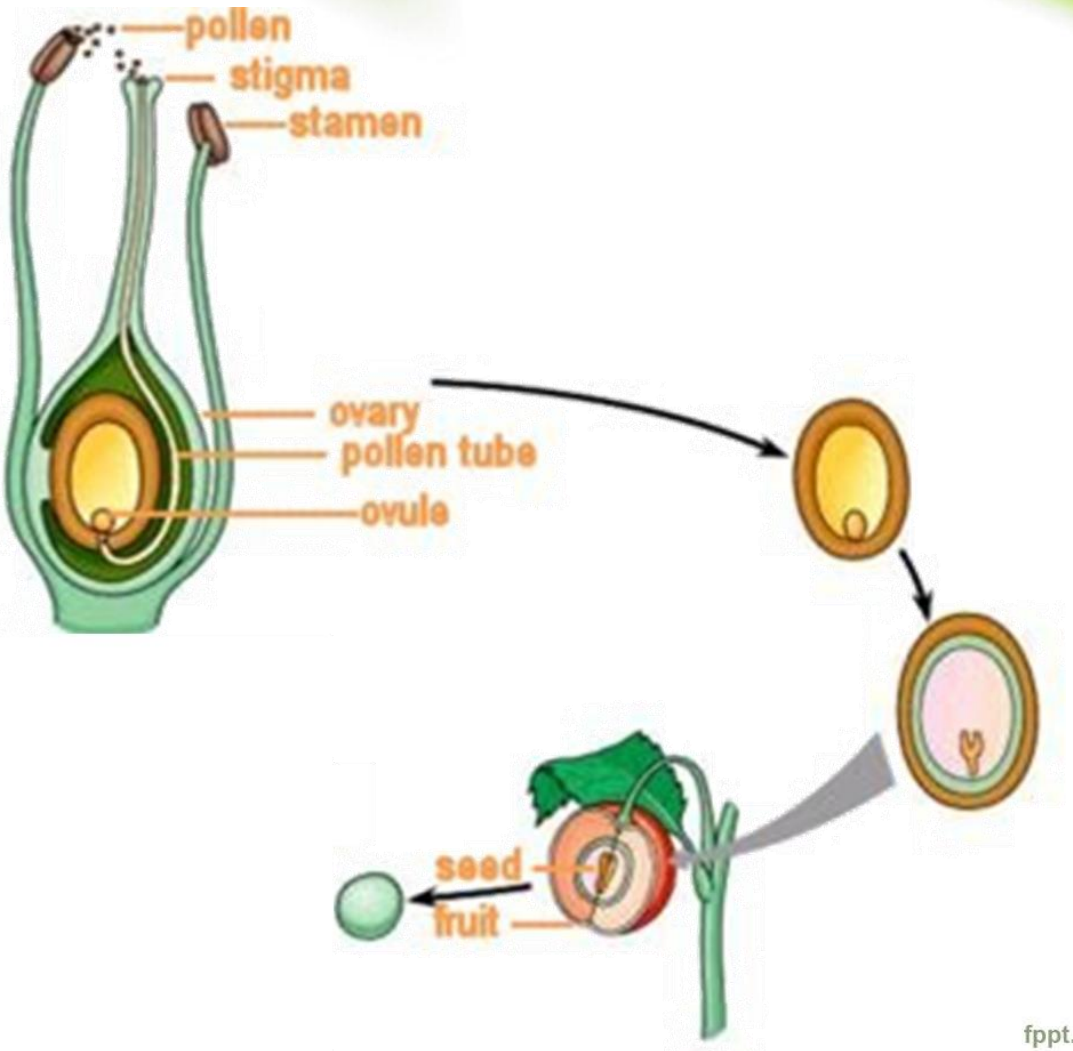
The formation of seed and fruit from ovule and ovary

extra info

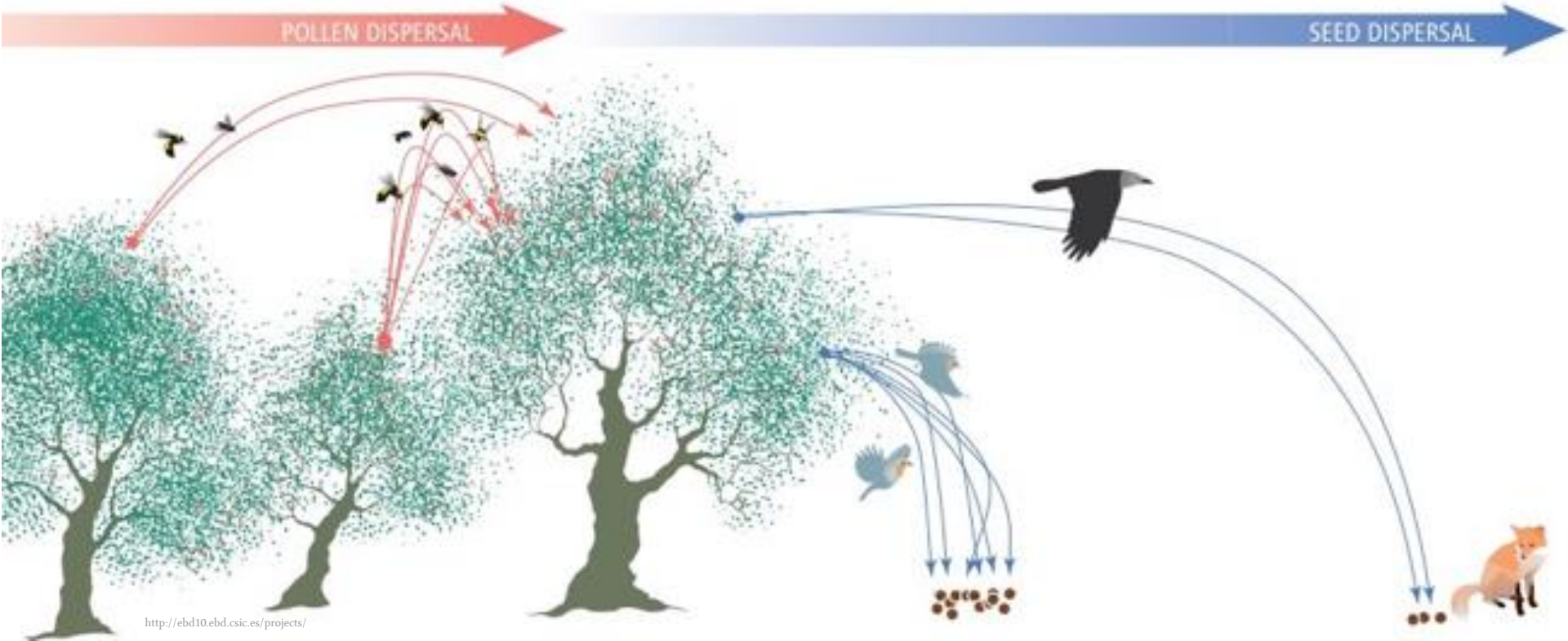
Once the flower has been fertilised by pollen the **ovary** grows to form the **fruit**.
The **ovules** become the **seeds**.
The outer part of the ovule grows into the seed coat. The **zygote** grows into the young plant – or embryo.

A fruit may have one or more seeds.
The petals, sepals and other parts of the flower start to die and fall off.



Seed dispersal

Pollen is dispersed (or spread) from plant to plant so the flowers can be pollinated and fertilised seeds produced. Once the seeds are mature they then also need to be dispersed so they are not competing with the parent plant for space, light, water and nutrients. There are various ways that plants have evolved to disperse their seeds; forming inside fruit that animals will eat and spread, forming structures on the seed so the wind will carry them away, can float away, be forced away or tangle in the coat of an animal to be carried away.



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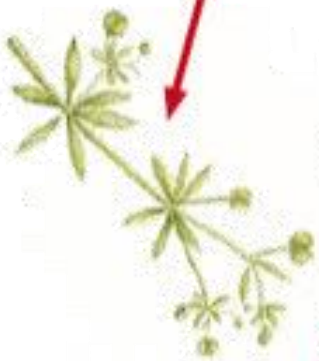
Seed dispersal

How are seeds dispersed?

By animals

hitch hikers
e.g. cleavers



takeaways
e.g. acorns

juicy fruits
e.g. blackberries

By the wind

winged seeds
e.g. sycamore

parachutes
e.g. dandelion

Self dispersal

pepperpots
e.g. poppy

exploders
e.g. Himalyan balsam

http://www.field-studies-council.org/breathingplaces/food_for_us.htm

Seed structure is linked to Seed dispersal

Animals

These fall into two main groups: fruits to attract animals to eat them or seed pods that are sticky or have hooks to attached to animals coats and be carried away

Wind

Most of these seeds are light and either have wings or plumes

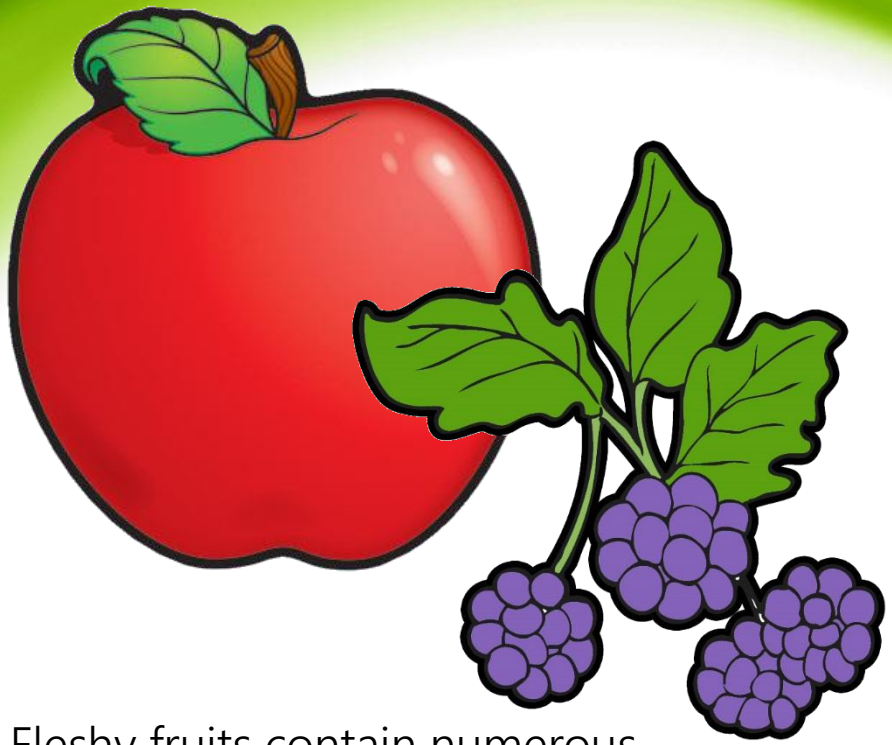
Water

Most of these plants have fruits which float. They become buoyant by trapping air.

Expulsion

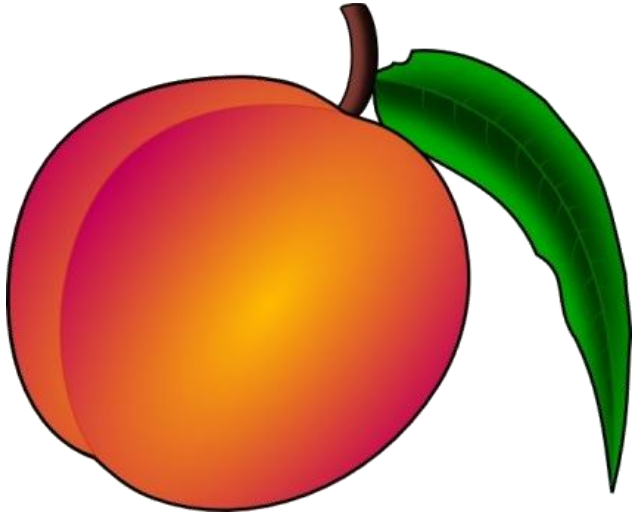
Fruits explode or burst and seeds are flicked away

Types of fruit



Fleshy fruits contain numerous small seeds either on the inside like the apple or on the outside like berries.
The seeds normally go through the animal when eating and are dropped out after the animal has moved away from the tree.

Like most fruit the colour, smell or size of the fruit attracts animals. Fruit like the peach with one hard inner seed are known as stone fruit. The fruit is usually carried off by the animal and eaten with the large stone in the middle dropped somewhere once all the sugary fruit is eaten.



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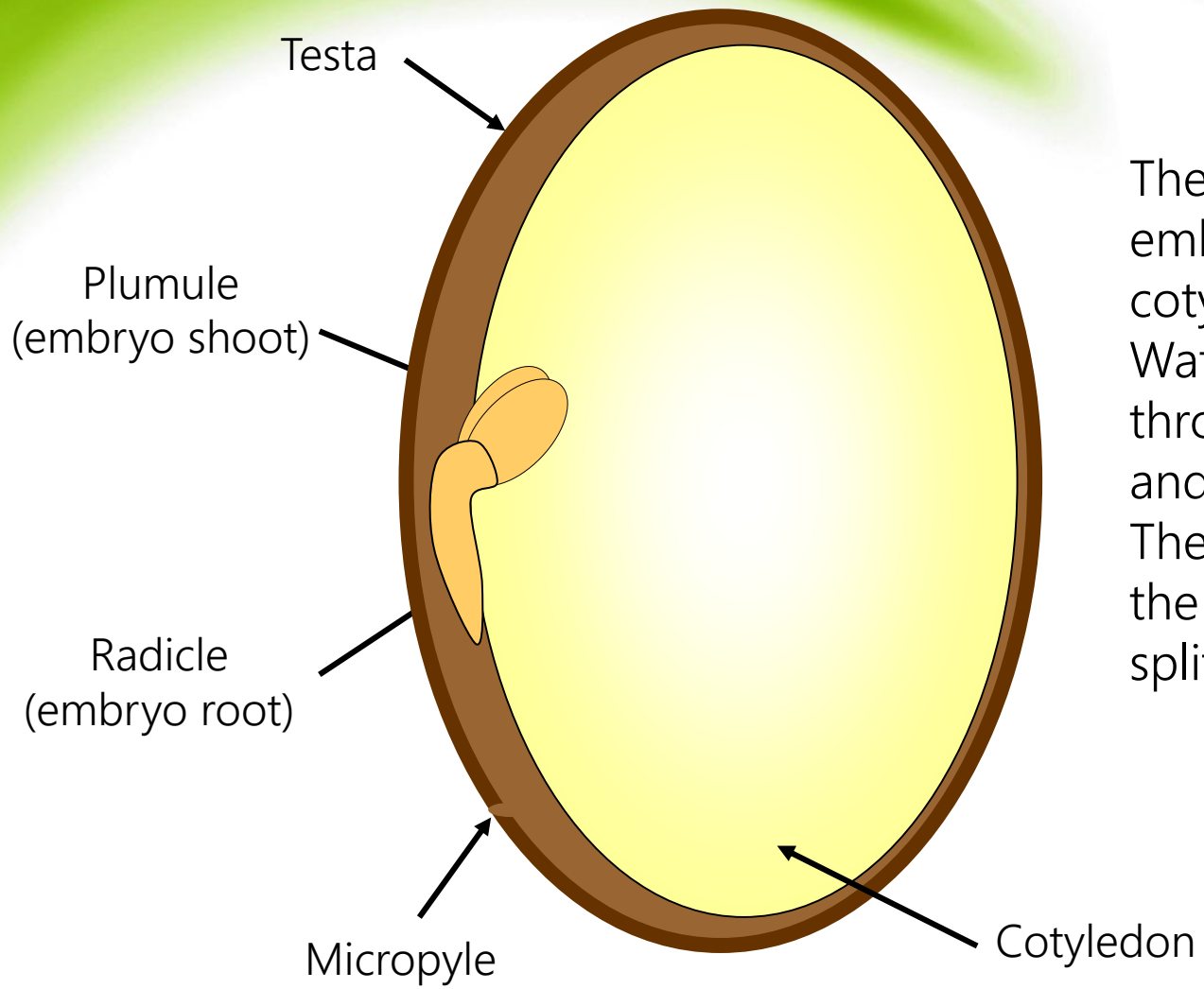
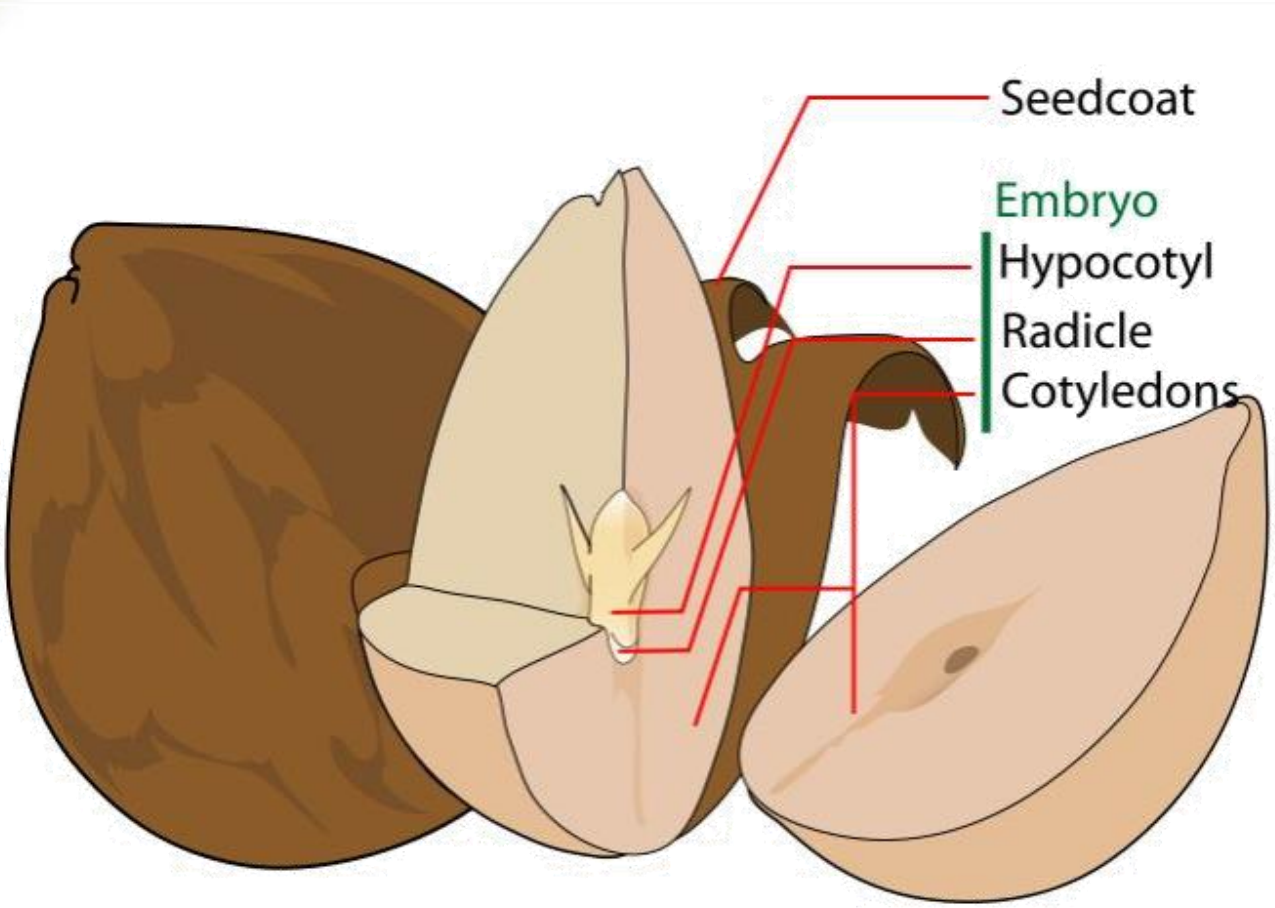
The Structure of seeds



The seed contains the embryo plant and cotyledons (starch stores) Water enters the seed through the micropyle and activates enzymes. The water also softens the testa to allow it to split.

The functions of parts of a seed



The seed consists of the seed coat or the **testa** which surrounds the **cotyledons** or the food storage area. The embryo consists of the **radicle** which is the embryonic root and the **hypocotyl** which forms the first shoots and leaves of the plant. A small pore in the seed may be seen called the **micropyle**. This is where the pollen originally entered the ovule.

The conditions needed for germination of seeds

Seeds will remain **dormant** until they receive (WOW)

Water

Oxygen

Warmth

Then they will **germinate.**

Other types of seeds may also require

>fire to burn seed coat

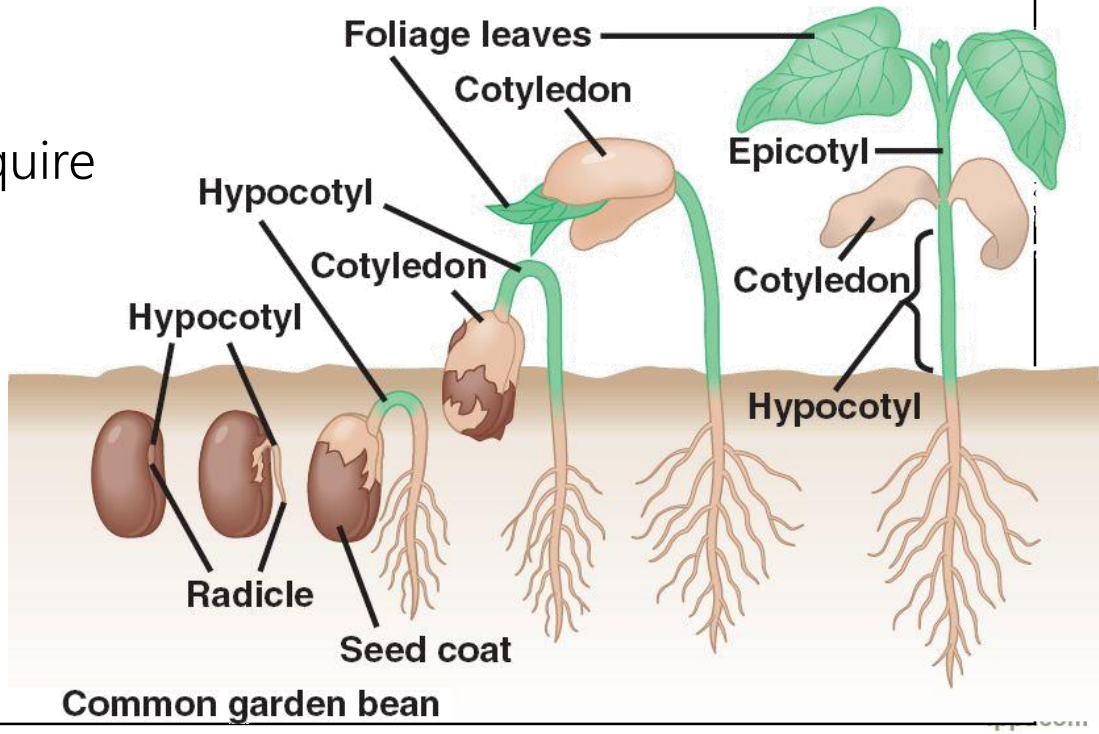
>light

>soaking in water

>scratched seed coat

>being digested by animals

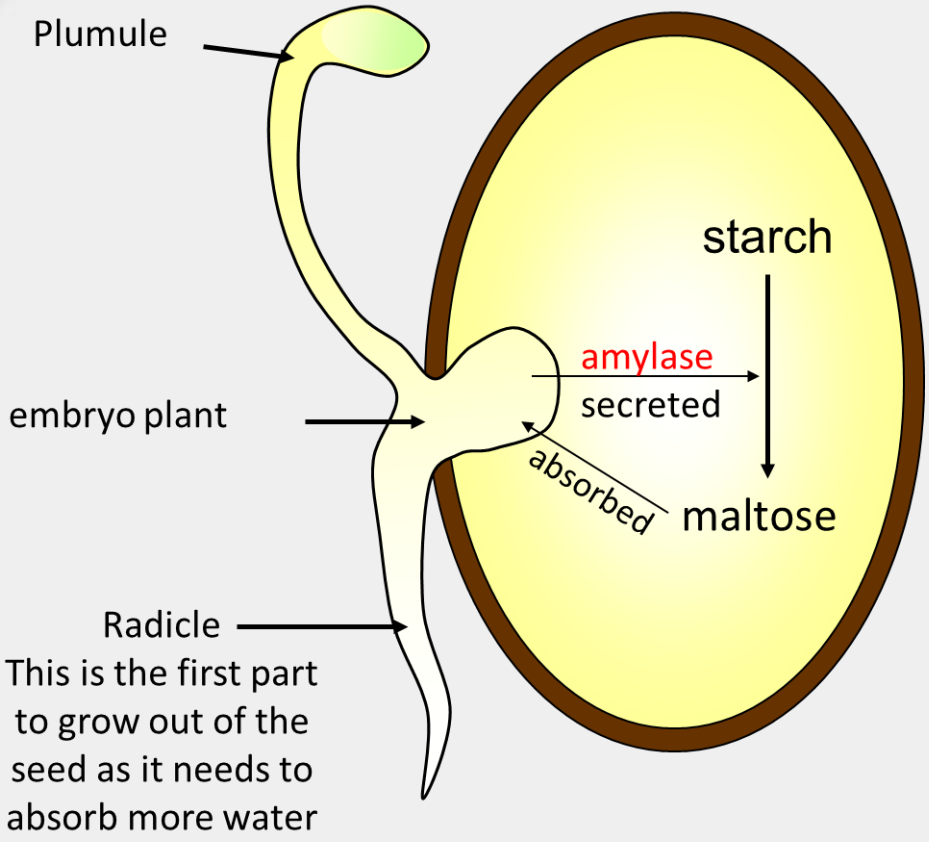
Before they germinate



Common garden bean

Background Knowledge

The conditions needed for germination of seeds



The enzymes break starch down into maltose and then glucose. The glucose is used in respiration to provide energy for growth

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The conditions needed for germination of seeds

Whilst germinating the plant uses food stores in the cotyledon to provide energy for growth

germination

The seedling can now photosynthesise and make its own food

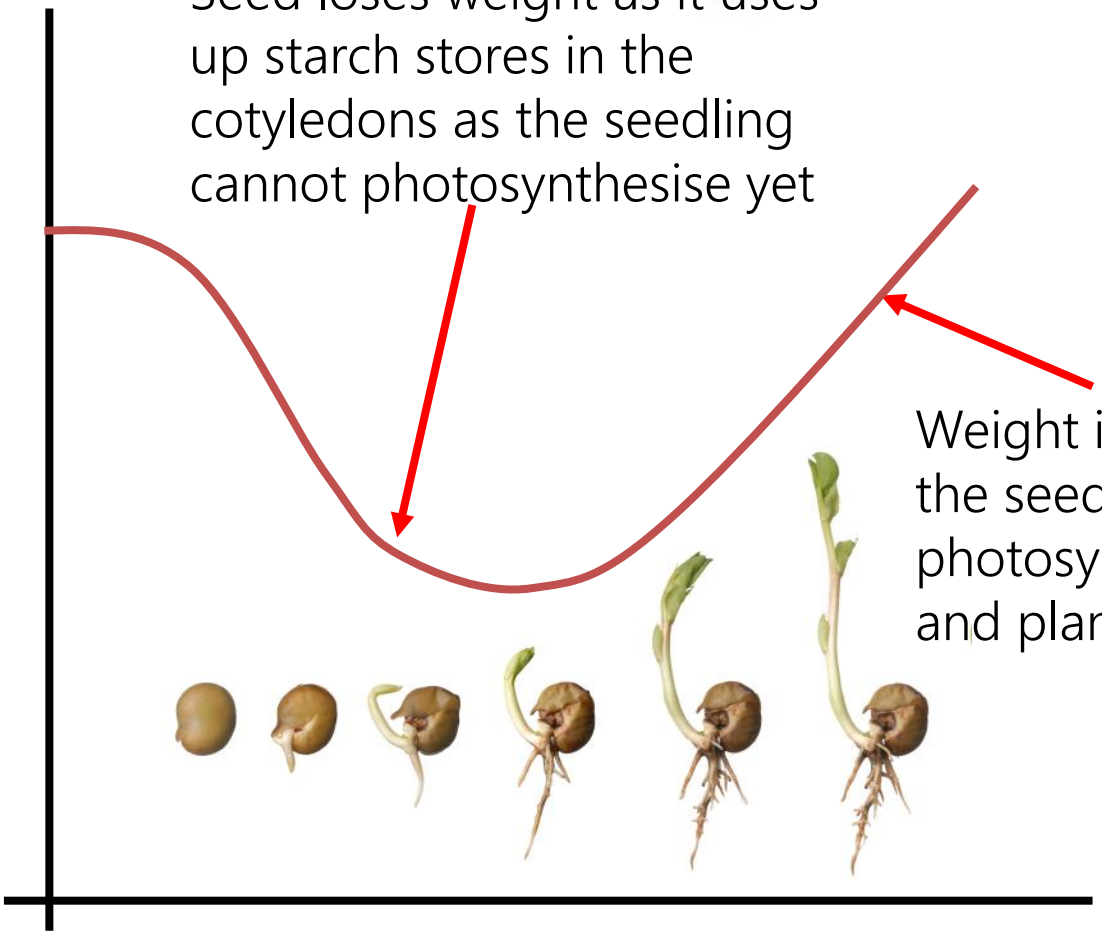
Plant growth and development

The conditions needed for germination of seeds

Seed loses weight as it uses up starch stores in the cotyledons as the seedling cannot photosynthesise yet

Dry mass/g

Dry mass is the mass of solid matter with all water removed

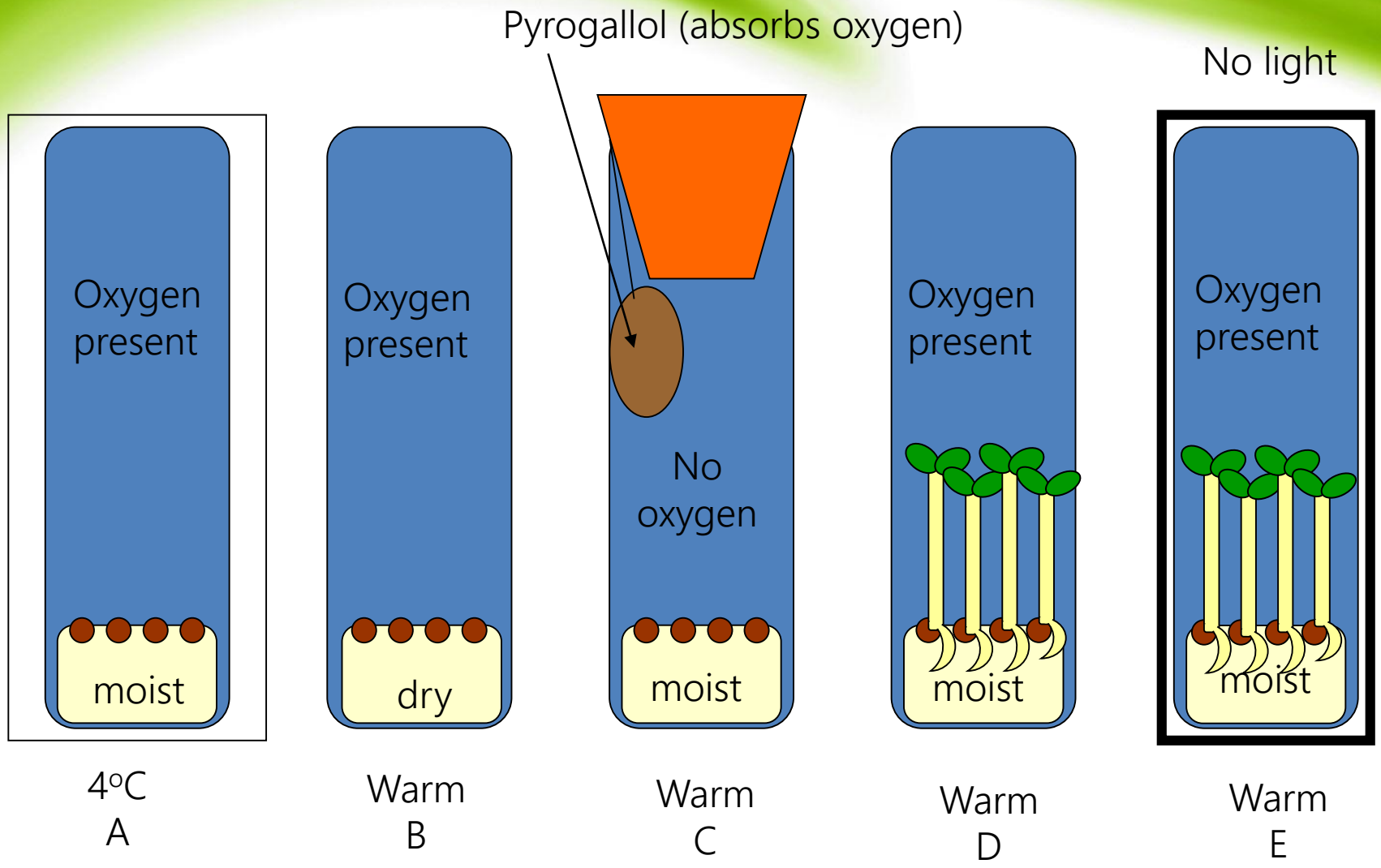


Weight increases as the seedling can photosynthesise and plant grows

Days

The conditions needed for germination of seeds

Summarise the findings of the experiment shown below:

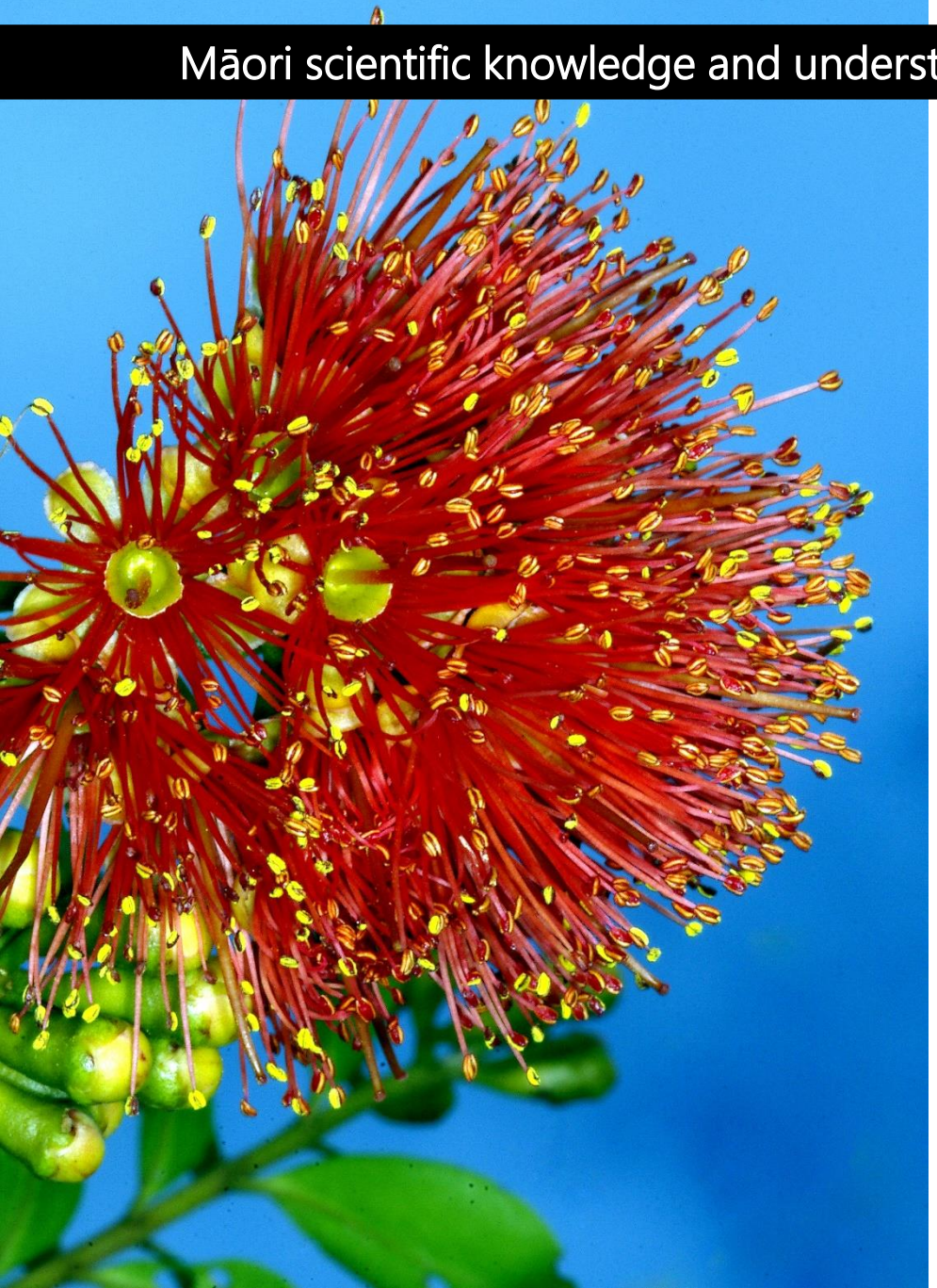


Māori scientific knowledge and understanding of their use of plants - Tawa

Over a long period of time Māori have built up their scientific knowledge and understanding of their use of plants for medicine (Rongoa), food, clothing and housing.
Many of these uses are still practiced today.

Tutu. Photographer: Michael Hall. © Te Papa & Ngati Toa. Tutu ointment being applied to arthritic wrist.

Māori scientific knowledge and understanding of their use of plants - Rata



The rātā tree bark can be made into a lotion or poultice, and the flower nectar can used for sore throats.

White and Red Rata from Maungatautari

Māori scientific knowledge and understanding of their use of plants - Kawakawa

Kawakawa can be made into a tea, poultice or chewed for tooth ache, sore stomach, and pains

Te Ara - The Encyclopedia of New Zealand
Photograph by Emily Tutaki

Kawakawa from Maungatautari

Māori scientific knowledge and understanding of their use of plants - Harakeke

The root can be boiled and then smeared it on as an ointment.

The flax root and leaf can be used for boils, bruises and bleeding, burns, toothache, worms, indigestion, measles.

Harakeke also has many uses as kete (baskets) and food carriers. The tough fibre in the plant can be used for fishing nets and traps, footwear, cords and ropes.

Various types (cultivars) of flax were seen as having specific uses by different iwi. 'Māeneene' - Ngāi Tūhoe -fine patterned mats. Ngāti Porou -'Tākirikau' - piupiu (kilts). 'Kōhunga' - Ngāti Maniapoto - finest cloaks.